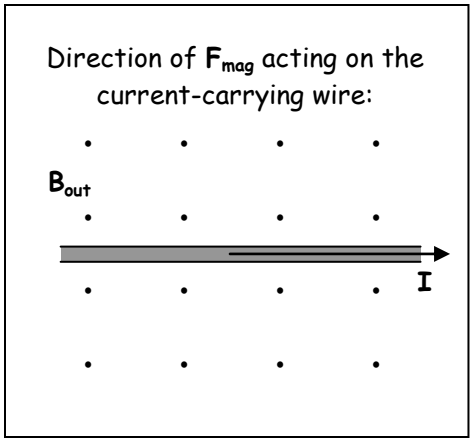
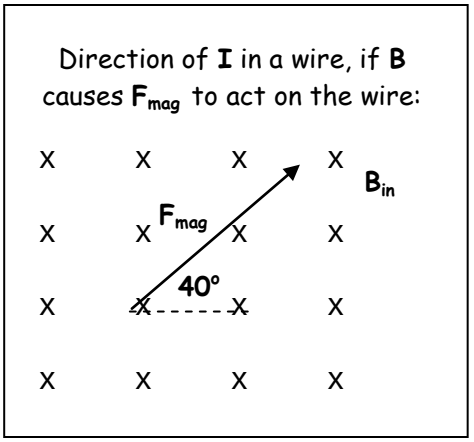
Magnetism

Chapter 20-21 In-Class Example Problems

Forces on Currents:

1. Determine the direction of the unknown quantity in the following scenarios:





2. Find the magnetic force (magnitude and direction) that will act on a 40cm-long wire carrying a current of 15A to the north, if it lies in a 0.03T magnetic field directed to the east.

3. A current of 15A is directed along the positive x-axis and perpendicularly to a magnetic field. The conductor experiences a magnetic force per unit length of 0.12N/m in the negative y-direction. Calculate the magnitude and direction of the magnetic field in the region through which the current passes.

Forces on Moving Charges:

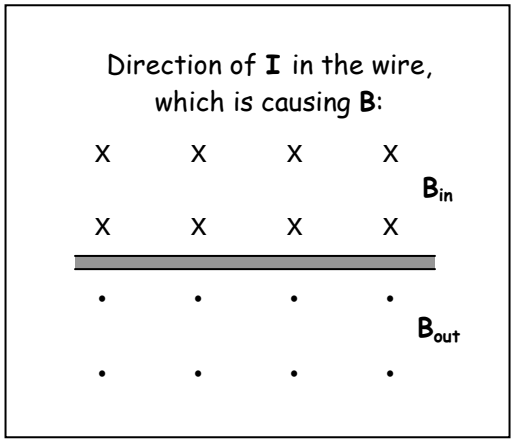
4. Determine the magnitude and direction of the magnetic force that acts on an electron traveling vertically upward at 3m/s in a horizontally-oriented B-field of strength 0.08T directed to the north.

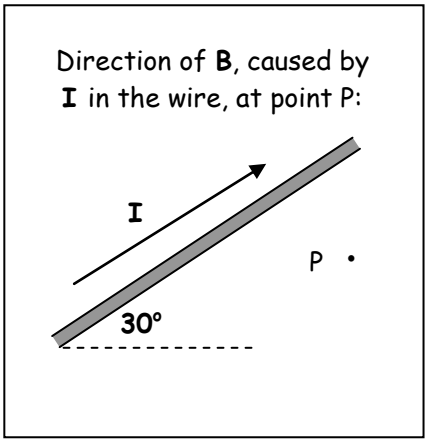
5. A proton is accelerated through a potential difference of 900V before it enters perpendicularly into a magnetic field of strength 0.04T. Calculate the magnitude of force exerted by the B-field on the proton.

6. An alpha particle ($m = 4m_p$, $Q = +2e$) enters perpendicularly into a 1.52T magnetic field at a speed of $7.6E^6$ m/s. What is the radius of the path taken by the particle?

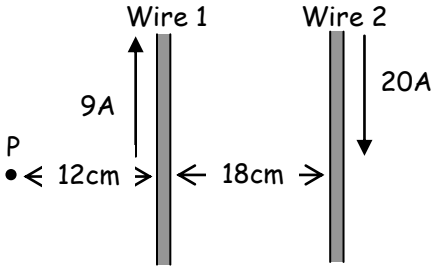
Fields due to Currents:

7. Determine the direction of the unknown quantity in the following scenarios:



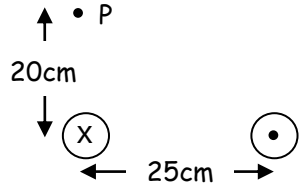


8. Wire 1 and wire 2 are separated by a distance of 18cm, and carry currents of 9A upward and 20A downward, respectively. Find the magnitude and direction of the net magnetic field at point P, 12cm to the left of wire 1.



9. For the wires in the previous example, find the magnitude and direction of the force that wire 1 is exerting on wire 2.

10. Two wires are oriented as shown in the diagram, carrying currents into and out of the page, as shown. Find the magnitude and direction of the magnetic field vector at point P.



Magnetic Flux:

11. A 23cm-diameter wire coil is initially oriented so that its plane is perpendicular to a 0.8T magnetic field. The coil is then rotated by 90°. Find the initial and final flux through the loop.

Faraday's Law:

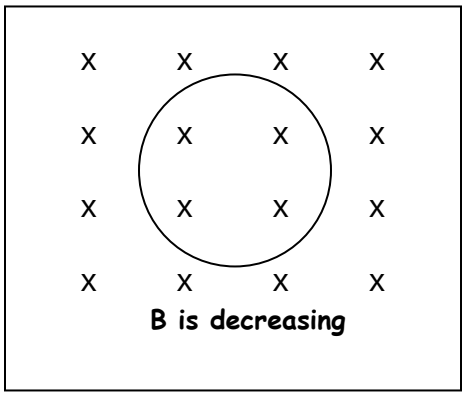
12. The magnetic flux through a coil of wire containing 100 loops changes from 32Wb to -32Wb in a time of 0.35s. If the resistance of the wire is 0.25Ω, calculate the emf induced in the coil and also the current induced in the coil.

13. A 20cm-diameter wire loop is placed in a 0.3T magnetic field. If the field is decreased to zero over the course of 0.85 seconds, what is the emf induced in the loop?

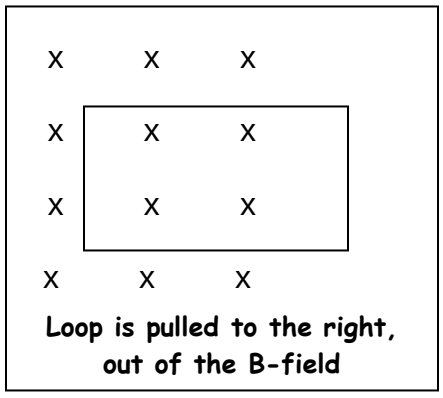
14. A 0.3Ω conducting bar, 10 cm in length, moves through a 4T uniform B-field. If the bar moves at 3m/s in a direction perpendicular to the B-field, find the potential difference induced between the two ends of the bar.

Lenz's Law:

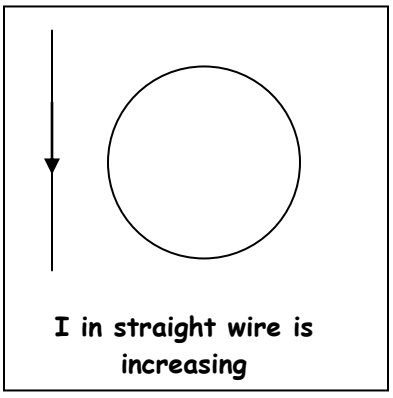
14. For each of the following examples, use Lenz's law to find the direction of the induced current in the wire loop.



B is decreasing



Loop is pulled to the right, out of the B-field



I in straight wire is increasing